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SUBSEA CABLE SYSTEMS and ACCESSORIES for Very Deep Waters

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Introduction

The interest for global surveillance is growing continuously. This has many reasons, but is mainly due to the global concern for changes in climate and movement of continental plates , as well as for military activity.

The world's oil and gas resources could be explored and better exploited through spontaneous or periodical monitoring. Moreover , man's desire to find answers to the BIG questions involves collection of data from outer space. The target of getting more oil out of an offshore field, or, monitoring nuclear testing , could be facilitated through a subsea system consisting of sensors and cable.

In this case the site selected for a 1 cubic km telescope is some 3500 m below the surface somewhere in the Mediterranean.

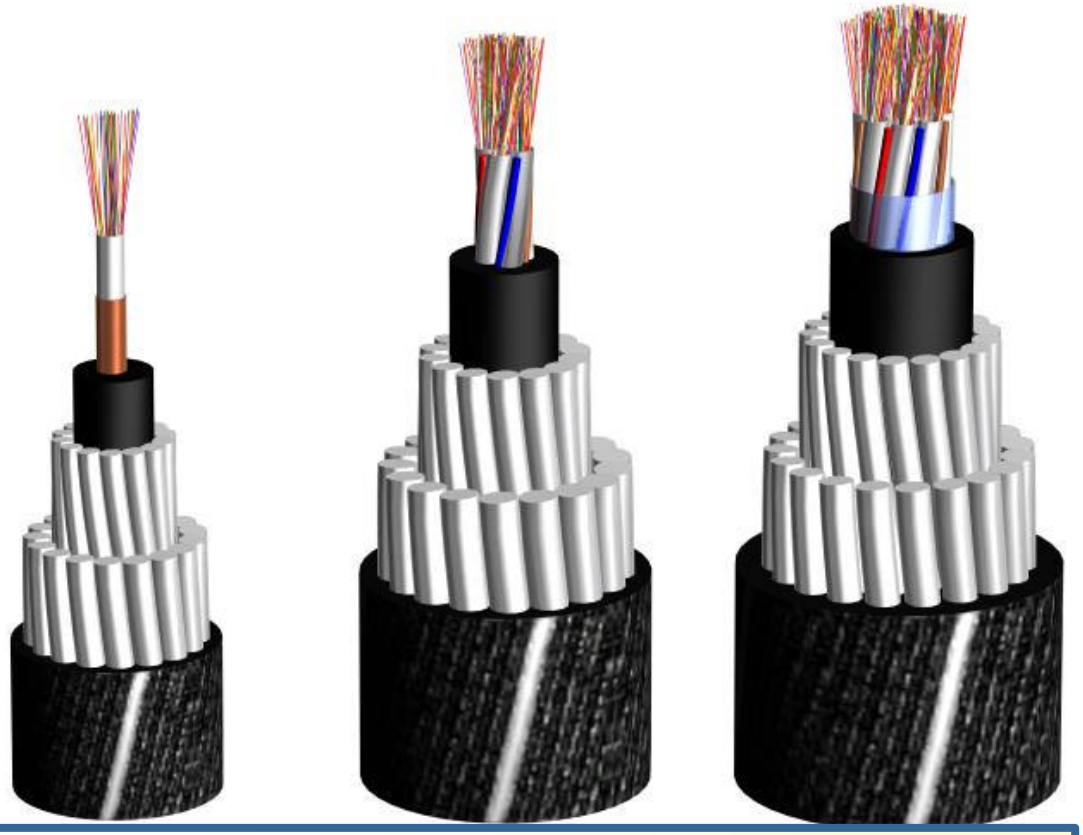
Presentation overview

- Nexans' jointing philosophy
- Nexans' URC-1 cable familiy
- The Deep Sea Link
- The Crohydro project
- The Catania project
- The Scarab-Saffron project - Nile Delta Deep
- Steel armoured umbilical down to 4000 m
- Conclusions

NEXANS NORWAY JOINTING PHILOSOPHY

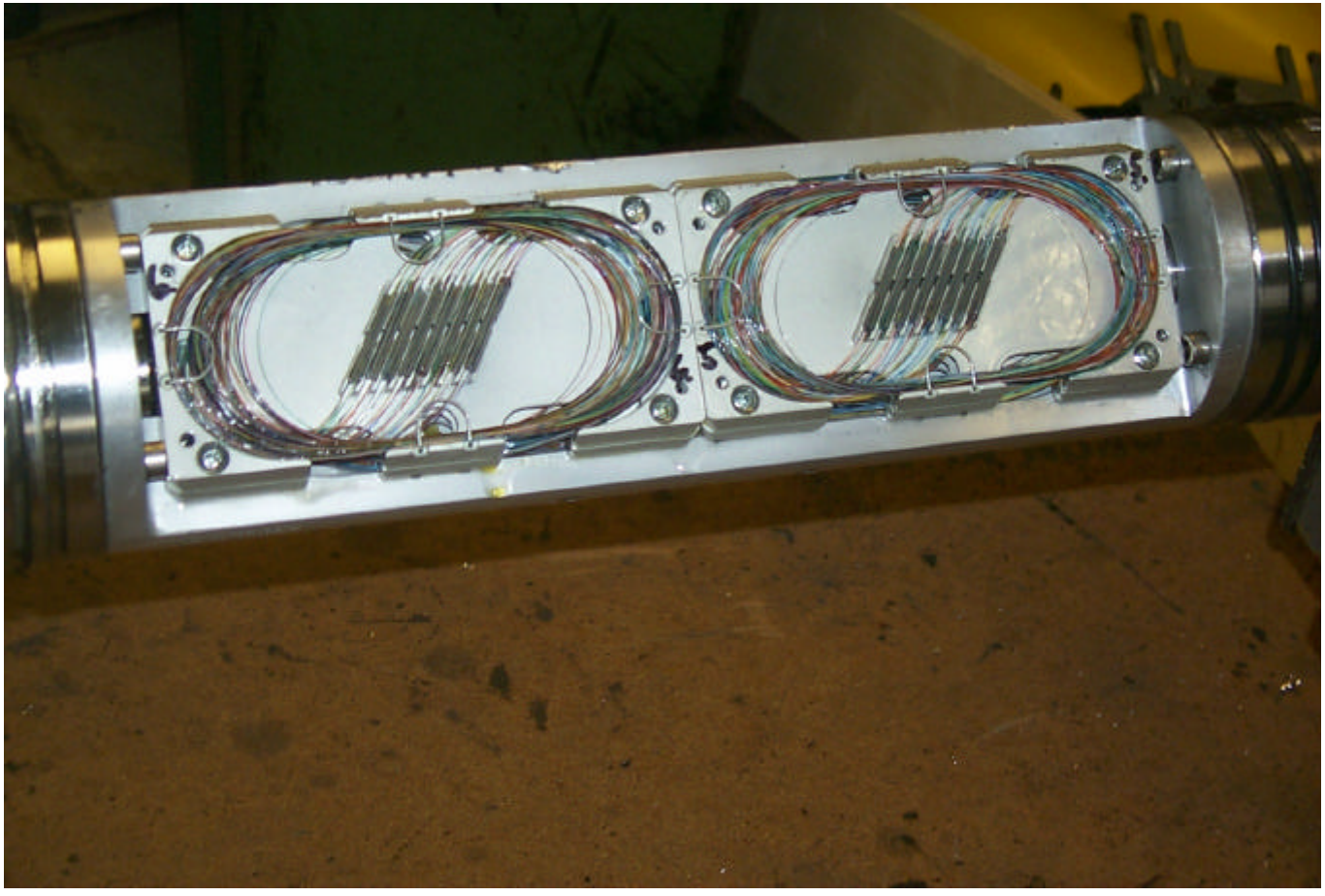
Nexans Norway main objective is to utilise jointing and assembly techniques that involve the opportunity to both assemble and repair offshore. This creates flexibility with respect to all key factors as technology, logistics and cost. This has been demonstrated by Nexans Norway's competent technicians onboard installation vessels in the telecommunication market with respect to Nexans URC-1 joint boxes for up to 384 fibres within its fiberoptic Unrepeteared Cable no. 1 family (URC-1) and URC-1 Branching unit since 1995.

NEXANS URC-1, >8000 km installed



Nexans URC-1 Double Armoured Cables with fibre counts up to 384 fibers

A reminder view is pictured below:



URC-1 Joint box for 384 fibres after qualification test disassembly

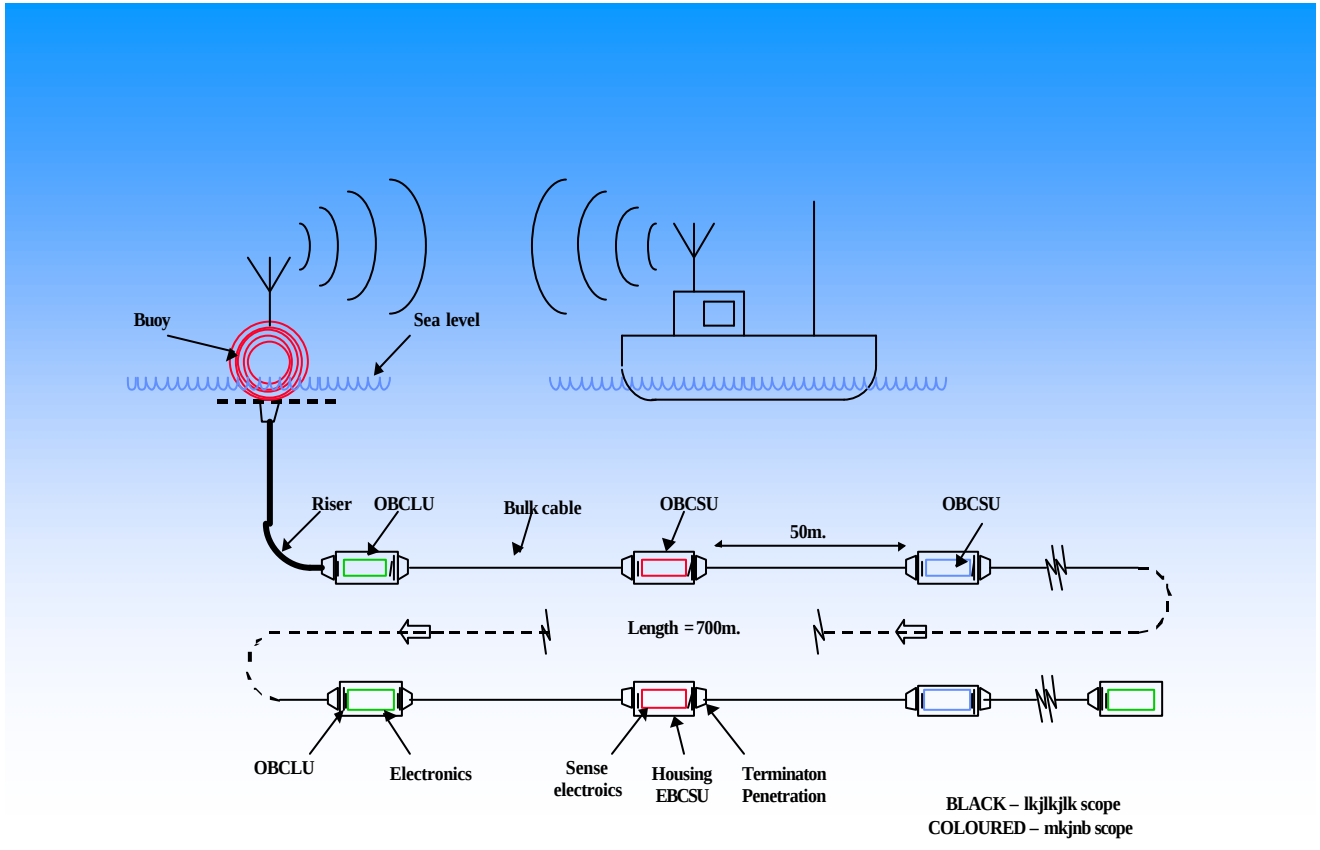
3 off FO ELEMENT JOINT BOX FOR HYBRID AC POWER CABLES

DEEP SEA LINK

Deep Sea Link comprises of a Nexans cabling system together with Sercel 408 architecture. This system is designed to be launched and retrieved for approximately 1000 times during its expected 25-year lifetime, in the purpose to explore for oil and gas by deploying a sensor system down to the seabed.

Deep Sea Link is the first seismic acquisition system specially designed for deep ocean bottom cable operations and reservoir monitoring down to 2000-m water depths. At such depths, system reliability as well as ease of deployment and recording are key requirements that have been successfully met in designing Deep Sea Link.

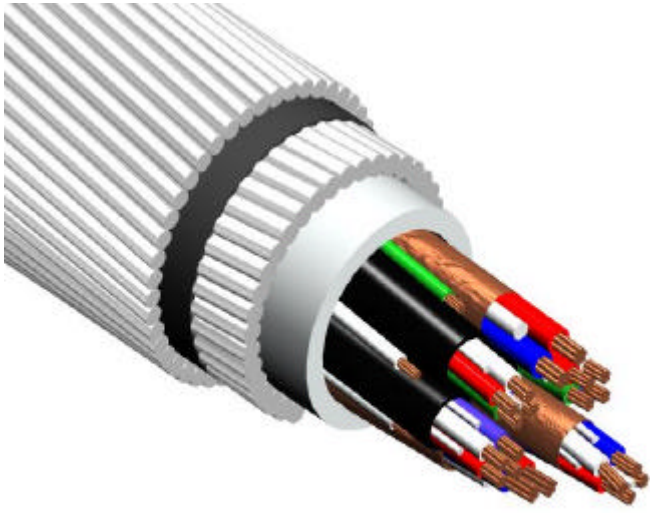
The system concept can be viewed as below:



“Plug and Play”

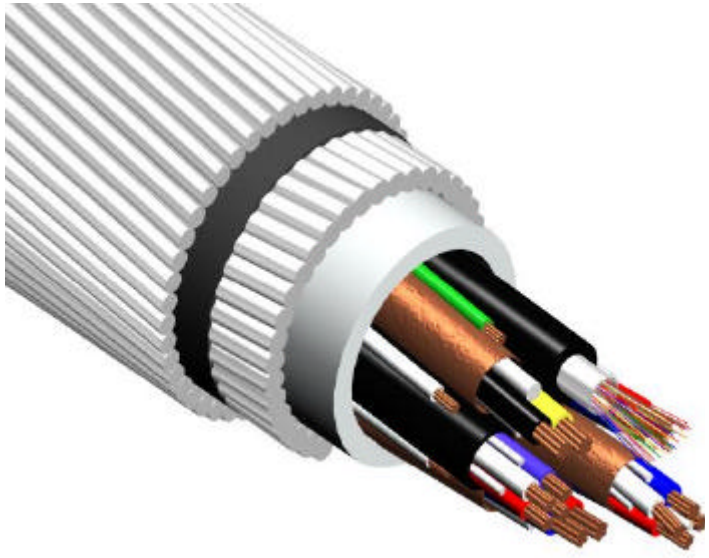
The Deep Sea Link seismic acquisition system has been tested in the field, and has proven to be very flexible. It can be deployed and retrieved from a standard vessel using containerised handling equipment. Field repairs involving the replacement of sensor units or cable sections can be done in a matter of minutes if necessary

The Deep Sea Link cabling system is described below:



The cable core of each **sensor cable** section contains four high performance telemetry quads and 8 power conductors.

Each cable section has a torque-balanced, steel wire armouring. The armouring is Galfan coated (Zn/Al alloy), thus giving an improved corrosion protection compared to standard galvanised wires.



The **riser cable** core contains a laser welded steel tube containing 12 optical fibres.
The cable core also contains two high performance telemetry quads and 10 power conductors. Apart from slightly different cable cores, the riser cable is identical in design to the sensor cable. The same mechanical termination can therefore be used for both cable designs.

The **cable termination** combines an armouring termination and a sealing mechanism designed to tolerate a pressure of 200 bar (2000-m water depth).
The termination is 190 mm long and has an outer diameter of 115-mm (139.5-mm including the outer ring nut).

Each cable section is mechanically terminated using a cone termination, and a high-pressure seal is made at the sheath. From this seal, all core elements run through oil filled chamber towards a high-pressure male connector. Both the connector and the sheath seal are qualified for a 2000-m water depth (200 bar).

The riser cable termination has a hybrid connector containing 19-pins and one fibre optic feed-through. The sensor cable termination has a 26-pin fully electric connector.

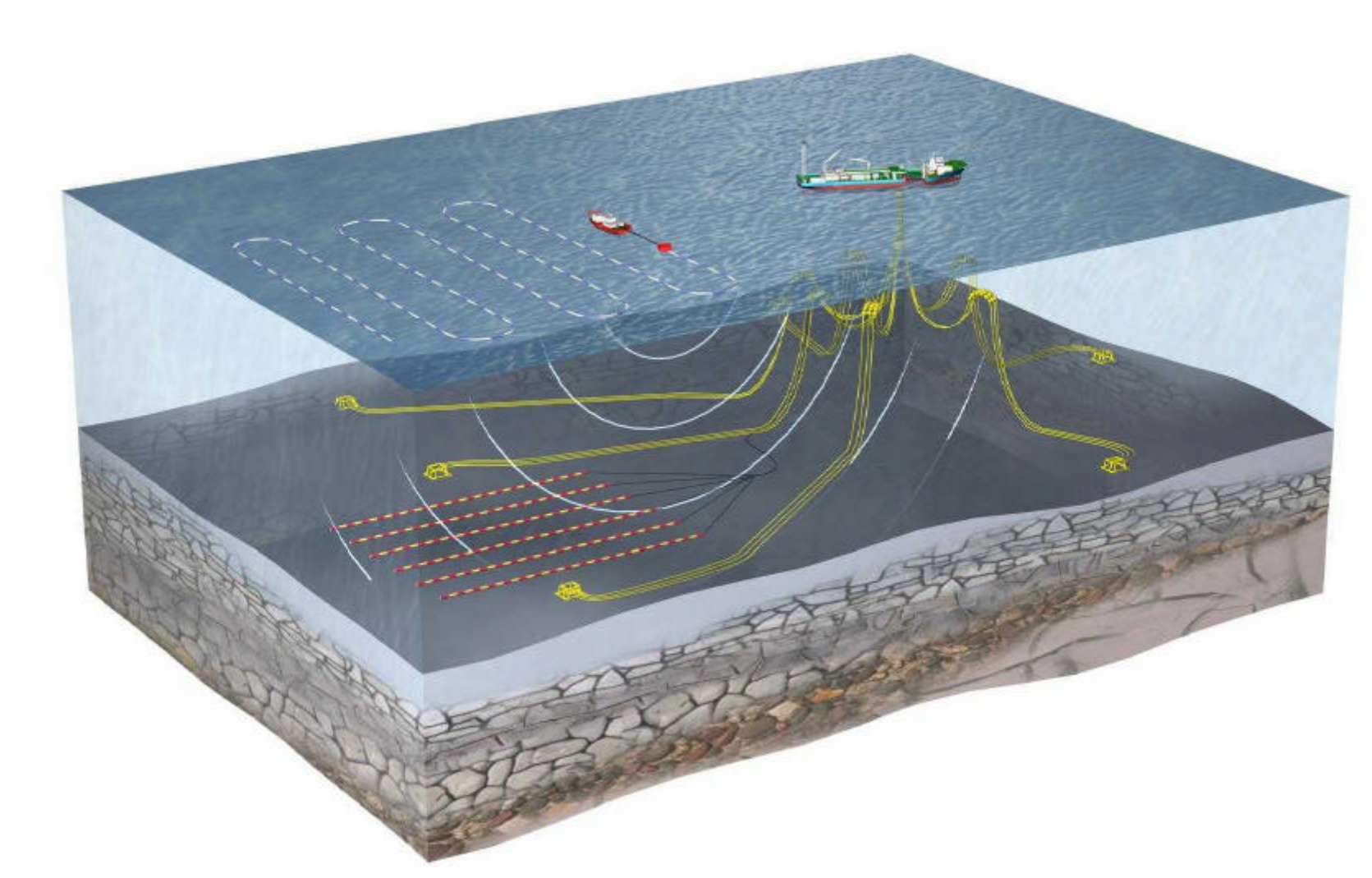
The termination is 190 mm long and has an outer diameter of 115 mm (139.5 mm including the outer ring nut)

Major Interior components in each sensor unit.

The Deep Sea Link seismic acquisition system is designed to be as flexible as possible. The cable termination is plugged into the sensor unit (or line unit), and locked with an outer ring nut. This operation can be performed in a matter of minutes, thus allowing the user to easily rebuild or repair a sensor array in the field.

Coupling of termination to sensor unit

Seismic Permanent System For Remote Field Monitoring



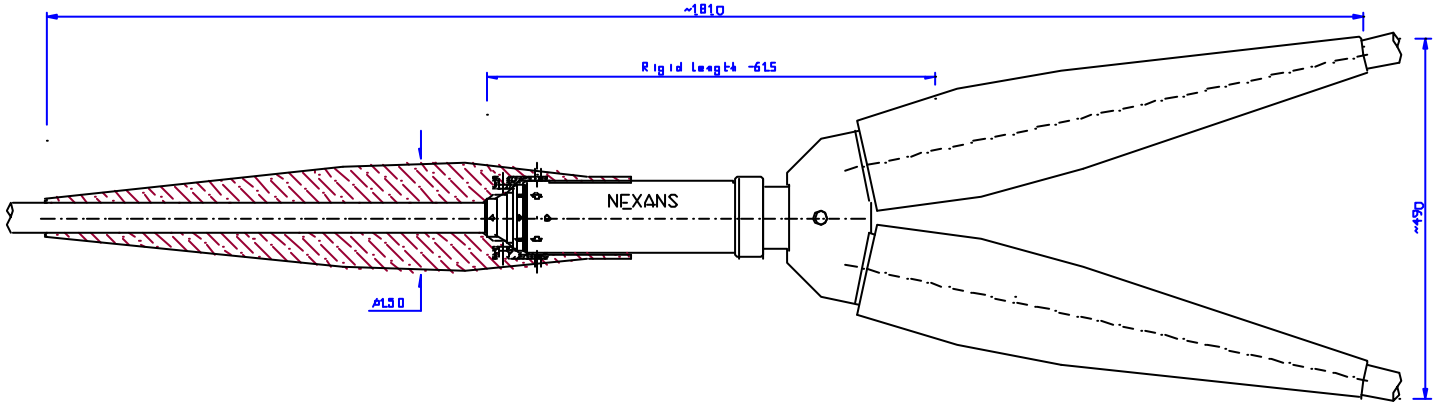
The Catania Project

You probably refer to the system off the coast of Catania as the Geostar:

Scientists are currently trying to discover the secrets of space through the monitoring of the radiation from outer space, which materialises itself in the smallest particles, called neutrinos. In order to get data, which are ready for interpretation, the scientists use the ocean as filter to exclude background noise. (This is just about what “simple” cable people have understood of the experiment.)

The Mediterranean proved to be an ideal test bed with depths of (more than) 3000m. Nexans Norway was together with Nexans Italy in charge of the supply of cable and branching unit. A third party undertook the installation of a 30-km long cable sensor system for INFN. The cable was uni-directionally armoured.

Below you see a picture of the cable and the design of the branching unit.



CROHYDRO

In 2002 CEA/DAM (Commissariat a l'Energie Atomique, Direction des Application Militaires) contracted Nexans Norway to build cable and accessories for the Crohydro project. The project entailed development, qualification and manufacturing of subsea cables and components for a permanent hydro-acoustic monitoring system. The project is part of a world-wide monitoring system established under the Comprehensive Test Ban Treaty (1996). The optical fiber cables and components were installed in 2003 off the Crozet island between Ile de la Réunion and the Antarctic continent, to connect 2 monitoring systems to the Crozet island. Needless to say that installation conditions were exceedingly challenging. The CEA/DAM undertook responsibility for installation using an experienced third party telecom cable installer. Today the cable system is installed and the system provides real time data over a satellite link.

In this context Nexans Norway assembled and participated in deploying two branching units in series.

The major system components were:

- Fibre optic sub sea cables
- Branching units, also serving as opto-electrical converters
- Fibre optic cable joints
- Cable joints to fibre optic cables manufactured by third party

Apart from focusing on system reliability, the project aimed at minimising time for installation. Short weather window and vessel operation costs in the Antarctic Ocean dictated this. The branching units and cables were thus developed around a “plug-in” concept, enabling pre-terminated cables to connect quickly to the branching units.

System components were qualified to external working pressure, as well as tensile loads, vibration, bump and thermal loads associated with transport, laying and operation at depths down to 1500 meter for 20 years.

Branching Unit vibration test.

Scarab - Saffron field development - example from the oil industry

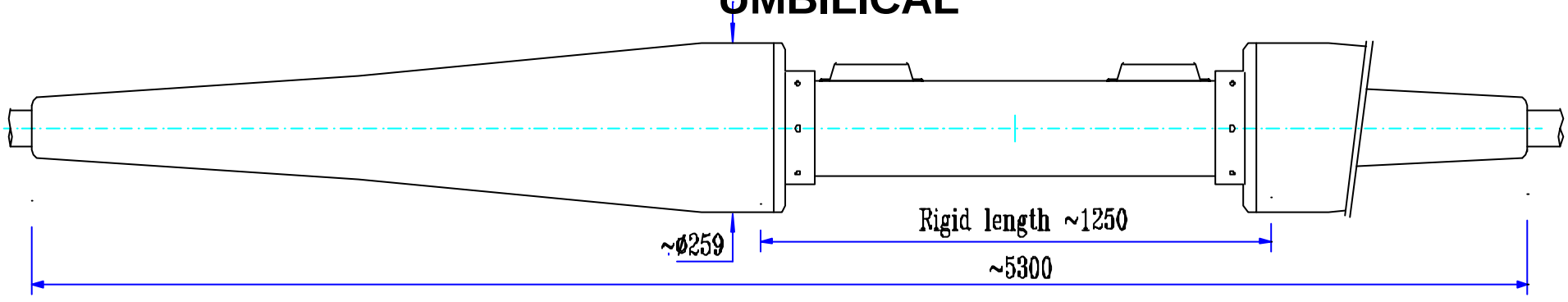
The Scarab/Saffron Field Development comprises 8 subsea wells and 2 manifolds. Each well is connected to the subsea control system by an infield umbilical, providing electric power and signal transmission, hydraulic pressure, vent and methanol. The subsea control system is connected to the onshore facilities by one electric and one hydraulic umbilical.

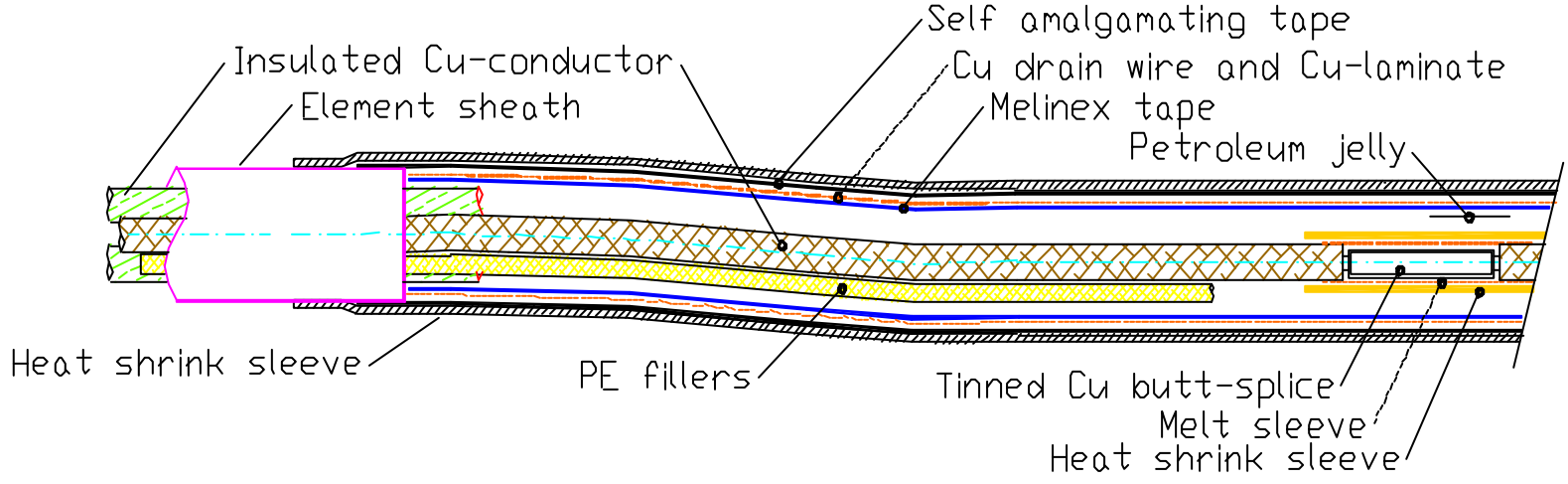
Nexans Norway's delivery comprised a 88 km unspliced hydraulic umbilical, a 88 km unspliced electro-optical umbilical sand 8 infield umbilicals of various lengths.

Scarab -Saffron

Below are the 3 different umbilicals that were installled in the Nile delta this year. Each umbilical was required to have a qualified joint in case of need for repair.

REPAIR JOINT FOR ELECTRICAL/OPTICAL UMBILICAL



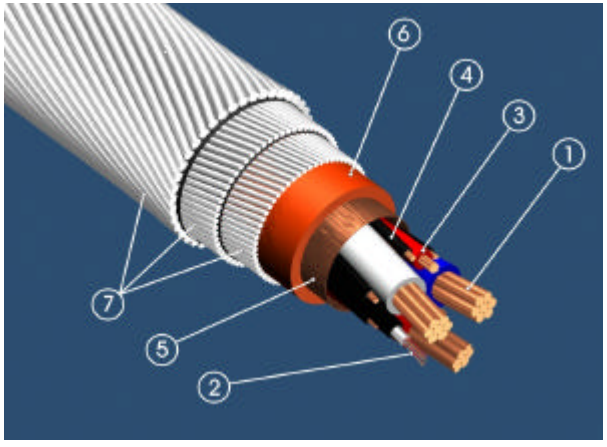


Steel Armoured ROV Umbilical with 4000m depth rating

Investigation of the submarine topography and geology, installation on seabed and exploration of resources are moving towards deeper waters. Hence, control umbilicals used for for ROV´s must be designed for more challenging operational conditions.

By going deeper, attention has to be paid to the cable weight and dimensions as these are the main contributors to the mechanical forces acting on the cable. At the bottom section, the hydrostatic pressure has to be taken into account. It it is of importance to keep the outer dimension at the lowest possible level, so as to reduce hydrodynamic drag forces and strumming acting on the cable.

A Technical Description of the 4000m cable design is available upon request; refer to RS035.



1 Power Supply, ROV motor
Three 16mm^2 Copper Conductors rated to 3.3kV. Capable of transferring up to 200kVA over 4500m of cable.

2 Signal
A selection of max 12 SM/MM optical fibres protected by a laser welded steel tube.

3 Power Supply, Instrumentation
Two 1.5mm^2 Copper Conductors supplying power to the ROV instrumentation.

4 Earth Conductors
Copper Conductors with semiconductive insulation, used to detect fault currents and drain any charges building up in the cable.

5 Shield
Copper Laminate increases the effect of Earth Conductors.

6 Sheath
A layer of thermoplastic polyester is applied. Protects the cable core and enables easy termination.

7 Armouring
Three layers of high-strength steel wires provide tensile strength and torque balance.

4000 m ROV umbilical main characteristics

Main Mechanical and Environmental Characteristics

Characteristics	Unit	Value
Cable outer diameter	mm	32.8
Weight in air	kg/m	4.3
Weight in sea water (1.025 kg/dm^3)	kg/m	3.6
Minimum dynamic bending diameter	mm	1500
Safe working load	kN	210
Breaking strength	kN	700
Operational Depth, max	m	4000
Power conductors, ROV motor	mm^2	16
Power conductors, Instrumentation	mm^2	1.5
Fibre optics, MM + SM	No	12

All materials are carefully selected with respect to environmental impacts during manufacturing, handling and after service. The environmental management of Nexans Norway conforms to the environmental standard EN-ISO 14001. Furthermore, the quality system conforms to EN-ISO 9001.

Data sheet for all materials can be provided on request.

Temperature Performance

Transport and Storage: -40 ... +60 °C

Operating: -10 ... +60 °C

Delivery Parameters

ROV cables are delivered on drums in one length.

CONCLUSIONS

Nexans Norway has the following to bring to the cubic-km development:

* Extensive and field proven deepwater experience down to 4000 m using steel armour - recently field proven in the Prestige tanker inspection and pumping preparations
* Qualified product down to 6000 m water depth using aramid yarn armour
* In-house engineering capability of design, qualification and supply of Branching Units, Repair Joints and Umbilical Termination Heads.
* Capability and capacity of supplying very long un-spliced lengths.
* We are looking forward to the years ahead !